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Monitoring of Eureka Sportsmen's Club Lake, 1994

by David L. Hullinger
Office of Water Quality Management

Prepared for the
Eureka Sportsmen's Club
Eureka, Illinois

March 1995

Illinois State Water Survey
Chemistry Division
Champaign, Illinois

A Division of the Illinois Department of Energy and Natural Resources

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CONTENTS

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The author again wishes to thank the Eureka Sportsmen's Club for all then-positive input to further increase the quality of the lake water.

MONITORING OF EUREKA SPORTSMEN'S CLUB LAKE, 1994

INTRODUCTION

The Illinois State Water Survey was asked to continue monitoring the Eureka Sportsmen's Club Lake from April - October 1994. This is the fifth consecutive year for lake monitoring. A priority in 1994 was dealing with high populations of duckweed that contribute to depressed dissolved oxygen (DO) levels.

With the installation of a horizontal flow paddlewheel brush aerator mixing device in late 1993, it was hoped that enough DO would be added to overcome the lake's very high oxygen demand, and thereby prevent possible fish kills during the next summer season. This high oxygen demand is due principally to organic rich bottom sediments and also because of the shading effect of duckweed. Algae cannot photosynthesize oxygen when the prolific growth of duckweed on the lake surface prevents sunlight from penetrating to these algae.

Only by using the paddlewheel brush aerator to keep the DO levels in the lake high enough to prevent possible fish kills, is it possible to treat the duckweed population. Without significant added aeration, the die-off of treated duckweed would use up so much DO as it decomposes that the DO level in the entire lake would drop to a level below which fish could not live.

METHODS

The same four monitoring stations used in 1993 were used again in 1994: 1) in the main body of the lake about 80 feet east of the destratifier at a water depth of about 16 feet, 2) in dog-leg bay about 50 feet out from the foot bridge, 3) about 100 feet east of the large bridge in the main bay, and 4) in the middle of the lagoon area near the boatshed.

Keith Cable accompanied the author during most monitoring sessions. Sixteen trips were made to monitor the lake at two-week intervals, starting April 14 and ending October 28.

Measurements of DO and temperature were made using a YSI Model 59 DO meter connected to a 40-foot cord with sensing probe. Measurements were taken at the surface and at one-foot intervals to the bottom of the lake. Secchi disc readings were taken at the deep station, and the lake level at the spillway overflow culvert was also recorded.

RESULTS AND DISCUSSION

The destratifier located at the deepest part of the main body of the lake was operated throughout the monitoring season. Initially, it was set to push water up. After monitoring on April 29, however, the unit was adjusted to push surface water downward for the rest of the monitoring season. This change in direction immediately increased oxygen levels in the bottom waters.

The surface-mounted paddlewheel brush aerator located in the west end of the main bay, just across the earthen walkway from the boatshed, began operating on June 3. When this unit was turned on, DO levels in the upper half of the lake doubled in less than three days.

Algae

No visible signs of algae were apparent until June 1, when much cut-grass algae was observed throughout most of the entire lake, except in an area around the destratifier. The term "cut-grass" algae is derived from the appearance of mostly blue-green algae clumped together and resembling grass clippings suspended in water. By June 6, even the area around the destratifier contained a high density of "cut-grass" algae, which was concentrated everywhere in the lake by June 10.

On June 11 and 12, applications of Diquot herbicide were made to control floating duckweed throughout much of the lake (see Table 1). Monitoring on June 17 revealed that the cut-grass algal population was reduced to about 10-20 percent of what it was on June 10. Apparently it had been partially controlled by the Diquot.

By June 30, two more applications of Diquot were made to control duckweed, and no cut-grass algae was visible to the naked eye. Some *Cladophera,* mossy algae, were noticed at various places on the lake.

By July 20, three more applications of Diquot had been made to the duckweed and watermeal on the lake. Although no cut-grass algae was observed, there was the strong odor of algal bloom and some areas of blue-green algal "green paint" in dog-leg bay and elsewhere. A few algal mats of *Cladophera* were noticed along the shorelines.

Conditions on July 26 were quite different. Even though Diquot had been applied on July 21, there was a modest amount of cut-grass algae everywhere on the lake. A considerable amount of green algae was noticeable throughout the lake, as well as several green paint blue-green algal blooms near the spillway. An analysis of this water revealed the dominant blue-green algae to be: *Anacystis Thermalis, Anabaena Spirordes*,*Aphanazomenon-flos-aqua*, and *Oscillatoria;* the dominant green algae was *Pediastrum,* and the dominant protozoan was *Vorticella Campanula.*

With three further Diquot applications, monitoring on August 12 revealed a greatly reduced population of cut-grass algae. Much blue-green algae was observed floating at the surface in many areas of the lake and was accompanied by the sour smell of blue-green algae. Several algae mats were present.

After the last two applications of Diquot on August 21 and 25, monitoring on August 29 showed a continued decline in the cut-grass population. Many small green algae clumps and scums were present along with the sour smell of blue-green algae.

By both September 16 and 30, the water in the lake appeared clear, with no apparent algal scums or cut-grass algae. Only a few algal mats remained near the dam and along the shore on each side of the swimming area.

Upon further monitoring on October 13, only a slight algal scum in dog-leg bay was noticed. Clear water was observed on October 28, the final monitoring date.

Duckweed and Watermeal

Duckweed and watermeal populations were in strong evidence in the lagoon, the inlet to the lagoon, and the west comer of the main bay on April 14, the first date of monitoring. Even at this early date, it was apparent that duckweed and watermeal were upcoming problems that would have to be dealt with this season.

By April 29, duckweed and watermeal had filled the entire lagoon area and were very prominent around the shorelines of the entire lake. This condition persisted through June 3 when the Fish and Lake Committee started treating the duckweed with Ortho Diquot, as recommended in the Illinois Department of Conservation publication, *Aquatic Weeds*. See Table 1 for dates and applications of Diquot. In all cases, a Diquot solution was actually sprayed onto the duckweed and watermeal plants, not just into the water. Since Diquot treatments should not be made without first knowing the concentration of DO in the waters throughout the lake, along with having a ready means of oxygen replenishment, the author kept in close touch with the chairman of the Fish and Lake Committee.

The first two Diquot applications were on the lagoon and partial areas in the main bay. No reduction in duckweed was noted. Applications on June 11 and 12 gave good results, as reported by Keith Cable on June 16: one third of all duckweed in the entire lake had disappeared and much remaining duckweed had a brownish color.

When monitoring the lake on June 17, the author noticed much whitish-ash color of the treated duckweed. New green duckweed and watermeal were again starting to flourish in the lagoon area. Much duckweed at various stages of dying was floating and swirling in the main bay due to the splash action of the paddlewheel brush aerator.

With adequate DO available on June 17, applications of Diquot were made and again on June 24.

By July 1, with adequate DO levels and continued thick growth of duckweed and watermeal in the lagoon and main bay, it was decided to use even larger doses of Diquot. Heavy treatments were made on July 1, 7, and 15. Monitoring on July 20 showed continued success with the Diquot applications; however, new duckweed was continuing to thrive. Additional treatments were made on July 21 and 25.

Monitoring on August 12 showed adequate DO along with reduced amounts of duckweed. Watermeal populations were very high, pointing to the fact that watermeal is not killed by Diquot doses that have been so effective in killing duckweed. Final Diquot treatments were made on August 21 and 25.

By August 29, the duckweed population had been reduced to an almost inconspicuous amount. Watermeal plants were still high in number. Some blue-green algae scum was observable, along with a sour algal smell.

Blue-green algal scums, and their accompanying odors, which had been somewhat controlled by early Diquot applications, no longer seemed to be controlled by the later applications. Duckweed was effectively reduced to neglible amounts by October 13, which was also the last appearance of watermeal plants.

Submerged Vegetation

One event that was noted during 1994 was the appearance of submerged vegetation rooted in the bottom sediments near the shorelines. This vegetation was found growing in areas where the bottom sediments were within 3 feet from the lake surface. A few plants of coontail (also known as hornwort) or *Ceratophyllum Demersum* were noticed for the first time on July 20 in the lagoon and dog-leg bay near the swimming area. Two coontail were again noticed on September 30 in the lagoon area along with several additional plants all along the south shoreline of the big bay from the overflow near the dam to well inside the dog-leg bay.

As the triploid grass carp that were added to the lake in earlier years die off, the submergent vegetation that was their main diet will regain prominency. Desired species of submergent vegetation are considered an asset to a fishing lake, as long as their numbers are not great enough to choke off sunlight access to photosynthesizing algae or cause other problems.

Rainfall

Rainfall amounts during the summer months were somewhat below normal. As a result, the lake level consistently dropped during the monitoring season. Table 2 shows lake levels for 1994. While 2 inches of water was flowing over the overflow at the beginning of the monitoring period on April 14, the lake level dropped constantly during the summer to a level 11.5 inches below spillway height on October 28.

This condition meant that very little fresh water was flowing into the lake from any source, and that again, as in 1991, the lake would need extra oxygen to aid the decomposition process. It was possible to meet this requirement through use of the paddlewheel brush aerator (located in the main bay) along with the destratifier (located in the deepest part of the big bay).

Secchi Disc Readings

Secchi disc readings were taken at the deep station for the monitoring done in 1994 and are recorded in Table 3. Many values below 25 inches are noted. The turbid values experienced are somewhat hard to explain due to the lack of rains bringing in expected turbidity. These lower values could make it harder for photosynthesizing algae to produce needed oxygen. Clearer water giving secchi disc readings above 30 inches permitted more oxygen production by photosynthesizing algae.

Dissolved Oxygen

DO concentrations in mg/1 for all depths at all monitoring stations are listed in Appendix A. DO concentrations at the deep station in big bay for surface, mid-depth, and bottom are shown in line graph form in Figure 1.

The DO concentration was quite high (10.4 to 9.3 mg/1) for surface, mid-depth, and bottom on the April 14 monitoring date. On April 29, however, the DO was 8.5 to 8.9 mg/1 at the surface and mid-depth, but was only 0.1 mg/1 at the bottom, indicating an absence of oxygen in the lowest level of the lake. It was quickly determined that the destratifier was pushing water upward. The direction of the destratifier was changed to push oxygen-enriched water downward, which caused the entire water column to be uniformly high in DO. This uniformity was next noted on May 13.

By June 1, duckweed and watermeal populations were quite high in the lagoon and were estimated to be 4 - 8 feet out from the shore around the entire lake. DO levels had fallen uniformly to around 4.5 mg/1. The paddlewheel brush aerator was started on June 3, and by June 6 the DO levels were 9.2 mg/1 at the surface, 7.5 mg/1 at mid-depth, and 6.4 mg/1 on the bottom at the deep station. Diquot applications to control the growth of duckweed and watermeal began on June 2 and 9, respectively.

By using the destratifier in the deep station, the paddlewheel brush aerator in the main bay, and 15 applications of Diquot mix to control the flourishing duckweed growth, the DO concentrations were kept above 4 mg/1 throughout the entire water column at the deep station for the remainder of the monitoring season, with one exception. That exception was when the DO fell to 2.4 mg/1 at the bottom on July 20. By July 26, the DO at the bottom had recovered to 5.2 mg/1. By mid-September, the paddlewheel brush aerator was turned off. With cooler temperatures and a controlled duckweed population, the DO remained quite adequate for a healthy aquatic habitat.

Water Temperatures

Figure 2 shows how water temperatures rose above 20°C on June 1 and did not get below this temperature until late September. During past years abundant growth of algae, duckweed, and watermeal have occurred at temperatures above 20°C. Depleted DO conditions have also occurred during this period.

SUMMARY

The April-October 1994 monitoring period again proved to be a challenging time. With duckweed and watermeal in strong evidence by mid-April, it became a formidable task to control the proliferation of their populations during the summer season.

By using the destratifier and paddlewheel brush aerator, Keith Cable, the Fish and Lake Committee, and other interested members were able to treat and control the rapid growth of duckweed in order to maintain the quality of the lake water throughout the summer season. Additional artificial aeration was also needed as the lake level declined throughout the summer season. Fish kills due to lack of oxygen were thereby prevented this season. Blue-green algal blooms were somewhat of a problem, however.

RECOMMENDATIONS FOR 1995

Recommendations for 1995 follow:

- Continue using the destratifier in the deepest part of the lake.

- Continue using the paddlewheel brush aerator in the main bay off the levee on an as-needed basis and according to Water Survey advice.

- Remove as many leaves, duckweed, and algal materials as possible. Treat for duckweed and algae when needed based on Water Survey advice.

- Monitor the temperature and DO profile on the lake twice a month from April through October.

Table 1. Diquot Applications, 1994

Date			*Amount*
June 2			3 gallons mix
June 9			3 gallons mix
June 11			15 gallons mix
June 12			12 gallons mix
June 17			12 gallons mix
June 24			24 gallons mix
Julyl	-	-	57 gallons mix
July 7	-	-	45 gallons mix
July 15	-	-	45 gallons mix
July 21	-	-	36 gallons mix
July 29	-	-	36 gallons mix
August 6	-	-	24 gallons mix
August 11	-	-	24 gallons mix
August 21	-	-	36 gallons mix
August 25	-	-	24 gallons mix
		Total =	396 gallons mix

Table 2. Lake Levels, 1994

Date	*Inches above or below spillway*
4-14	+2.0
4-29	+0.5
5-13	+0.3
6-1	-0.2
6-6	-1.0
6-10	-1.5
6-17	-2.5
6-30	-2.5
7-20	-6.7
7-26	-6.0
8-12	-9.0
8-29	-7.5
9-16	-9.0
9-30	-9.0
10-13	-10.5
10-28	-11.5

Table 3. Secchi Disc Readings, 1994

Date	*Distance in inches*
4-14	14
4-29	21
5-13	23
6-1	25
6-6	23
6-10	29
6-17	44
6-30	20
7-20	30
7-26	38
8-12	33
8-29	22
9-16	36
9-30	51
10-13	48
10-28	50

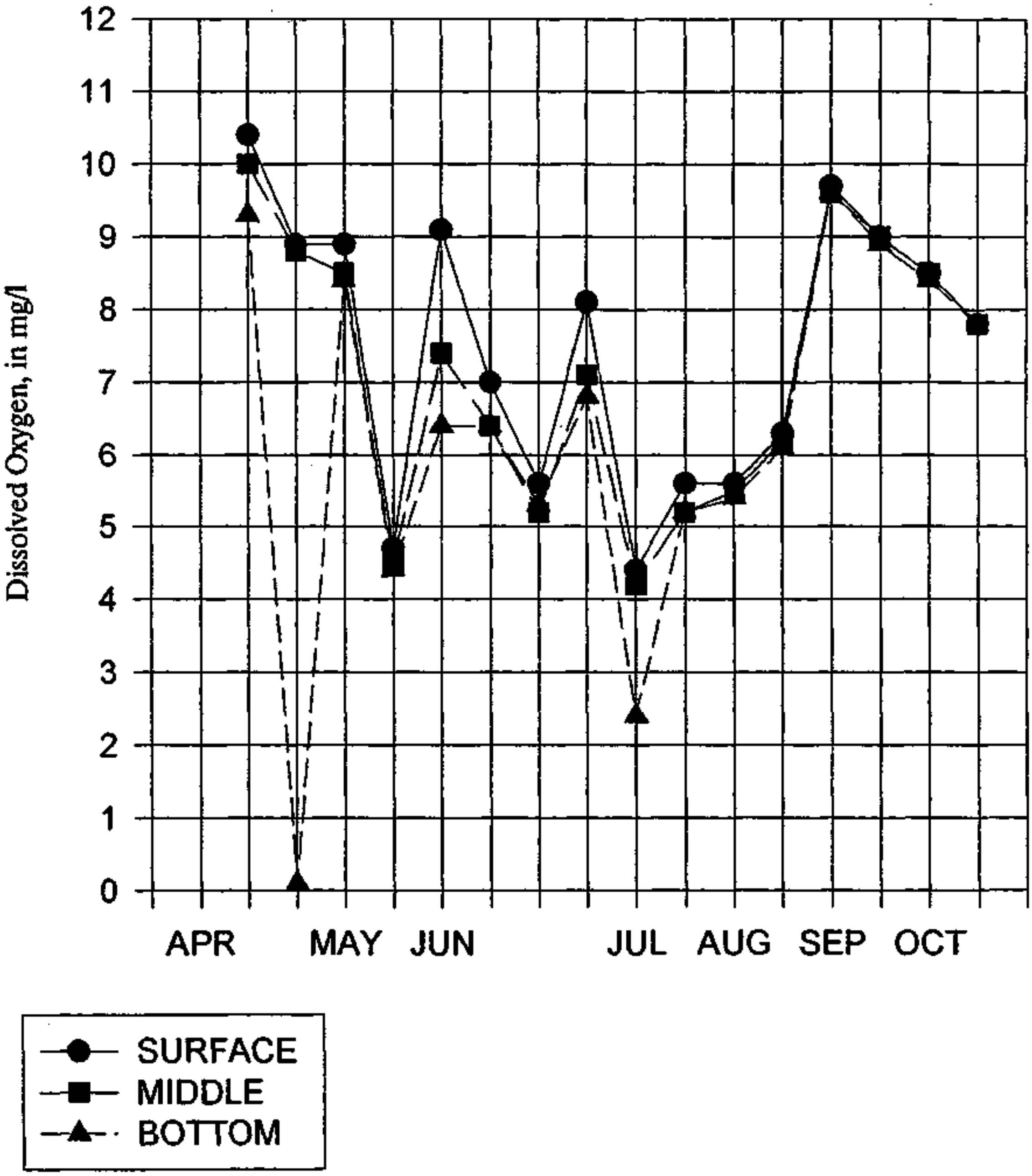

Figure 1. Temporal Variations in Dissolved Oxygen at Deep Station, 1994

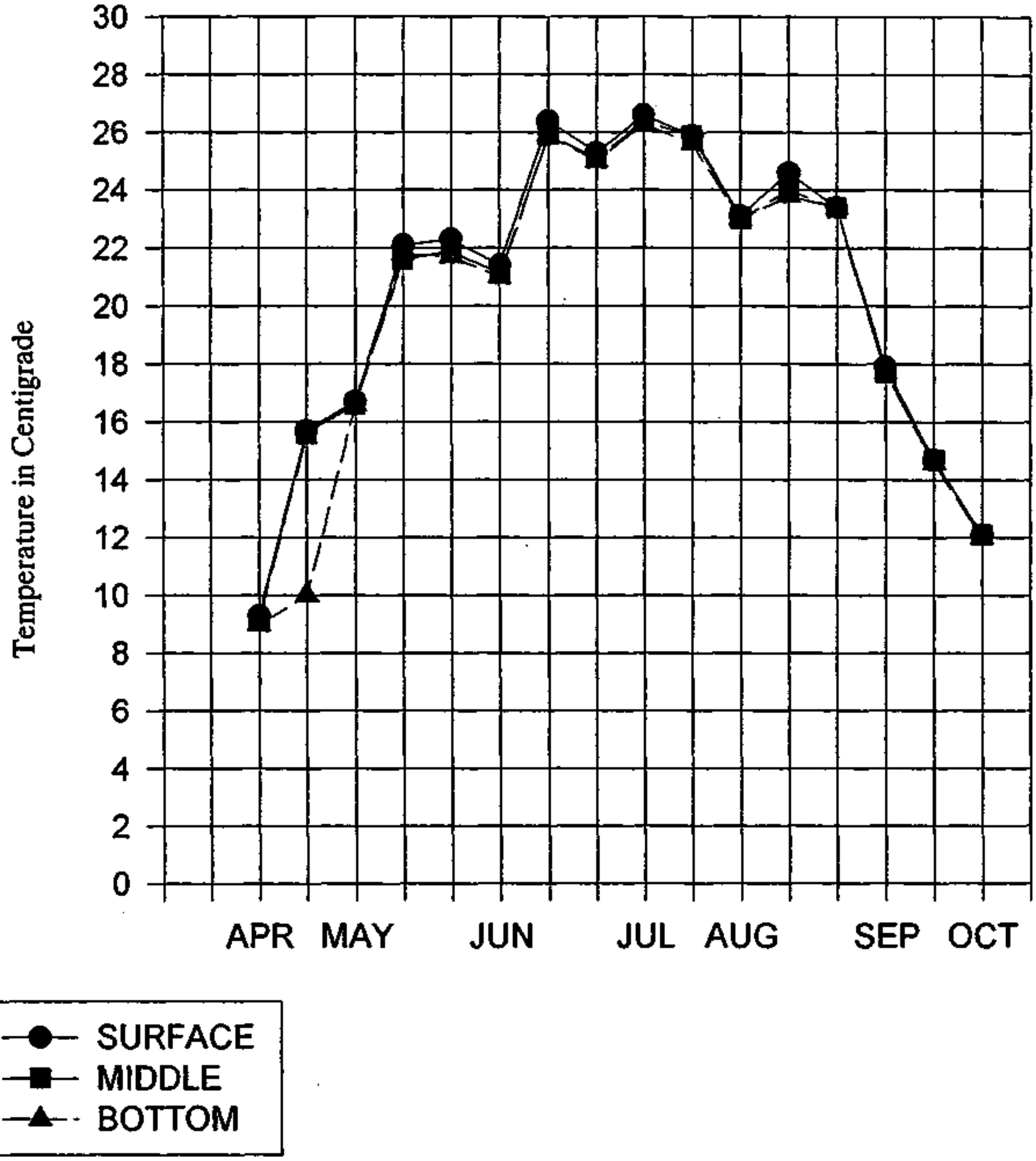

Figure 2. Temporal Variations in Temperature at Deep Station, 1994

Appendix A. Dissolved Oxygen Concentrations in mg/1,1994

Deep Station

Depth	4-14	4-29	5-13	6-1	6-6	6-10	6-17	6-30	7-20	7-26	8-12	8-29	9-16	9-30	10-13	10-28
0	10.36	8.88	8.86	4.70	9.16	7.05	5.60	8.10	4.42	5.55	5.63	6.33	9.70	9.04	8.47	7.81
1	10.37	8.90	8.85	4.62	9.05	7.03	5.56	8.10	4.42	5.29	5.61	6.35	9.72	9.03	8.47	7.82
2	10.35	8.92	8.65	4.60	8.10	6.99	5.24	7.47	4.34	5.30	5.59	6.34	9.65	9.04	8.48	7.81
3	10.35	8.87	8.60	4.59	8.05	6.93	5.22	7.43	3.97	5.48	5.56	6.34	9.64	9.04	8.49	7.80
4	10.08	8.82	8.57	4.58	7.98	6.76	5.20	7.18	3.95	5.48	5.55	6.32	9.64	9.02	8.49	7.80
5	9.96	8.81	8.55	4.55	7.61	6.46	5.14	7.14	3.92	5.25	5.55	6.27	9.64	9.01	8.48	7.79
6	9.90	8.76	8.53	4.54	7.55	6.42	5.20	7.10	3.92	5.22	5.53	6.25	9.63	9.01	8.48	7.79
7	9.84	8.69	8.49	4.54	7.52	6.41	5.21	7.06	4.16	5.21	5.52	6.20	9.62	9.00	8.46	7.78
8	9.83	8.65	8.49	4.53	7.35	6.42	5.22	7.06	4.18	5.22	5.51	6.08	9.63	8.98	8.45	7.78
9	9.80	8.63	8.53	4.52	7.30	6.43	5.25	7.05	4.21	5.21	5.51	6.03	9.63	8.94	8.45	7.78
10	9.85	8.57	8.53	4.52	7.24	6.43	5.25	7.06	4.23	5.20	5.51	6.02	9.62	8.94	8.46	7.77
11	9.90	8.52	8.53	4.53	7.22	6.43	5.26	7.06	4.24	5.24	5.50	6.03	9.62	8.93	8.47	7.77
12	9.91	8.43	8.54	4.52	7.18	6.42	5.27	7.13	4.26	5.26	5.49	6.04	9.62	8.92	8.47	7.77
13	9.90	3.50	8.53	4.51	7.06	6.40	5.28	7.27	4.26	5.27	5.48	6.07	9.63	8.92	8.45	7.77
14	9.90	1.48	8.54	4.50	6.86	6.38	5.29	7.24	4.26	5.27	5.48	6.10	9.63	8.92	8.44	7.77
15	9.32	0.20	8.54	4.48	6.83	6.34	5.28	7.10	4.00	5.29	5.46	6.11	9.63	8.90	8.21	7.76
16		0.14	8.54	4.46	6.40	6.36	5.27	6.78	2.35	5.23	5.38			8.88	8.40	7.76
16.5		0.13	8.43	4.45												

Main Bay

Depth	4-14	4-29	5-13	6-1	6-6	6-10	6-17	6-30	7-20	7-26	8-12	8-29	9-16	9-30	10-13	10-28
0	10.95	9.41	8.83	4.96	8.04	7.25	6.47	7.49	6.36	6.55	6.89	7.00	9.26	9.07	8..40	8.01
1	10.95	9.40	8.79	4.94	8.03	7.19	6.47	7.44	6.34	6.56	6.89	6.97	9.24	9.04	8.40	8.02
2	10.93	9.41	8.89	4.70	8.05	7.16	6.38	7.41	6.31	6.56	6.89	6.98	9.24	9.03	8.39	8.02
3	10.95	9.40	8.88	5.00	8.05	7.16	6.31	7.36	6.31	6.55	6.88	6.99	9.25	9.02	8.36	8.02
4	10.75	9.43	8.83	5.03	8.04	7.17	6.29	7.36	6.30	6.50	6.87	6.98	9.26	9.01	8.36	8.01
5	10.75	9.43	8.64	5.50	8.02	7.16			6.27	6.37	6.86	6.98	9.27	8.88	8.34	8.00
6		9.35	8.60	4.51	8.00	7.13			6.25		6.87		9.24		7.85	

Appendix A. Dissolved Oxygen Concentrations in mg/1,1994 (Concluded)

Depth	4-14	4-29	5-13	6-1	6-6	6-10	6-17	6-30	7-20	7-26	8-12	8-29	9-16	9-30	10-13	10-28
								Pop-Leg Bay								
0	10.80	9.65	8.83	4.80	8.95	7.12	5.66	8.55	4.12	5.85	6.05	6.35	9.00	9.03	8.15	7.50
1	10.75	9.66	8.79	4.86	8.76	7.09	5.65	8.55	4.10	5.81	5.99	6.38	8.92	9.02	8.15	7.46
2	10.70	9.38	8.89	4.83	8.30	6.85	5.65	8.16	4.04	5.76	5.88	6.40	8.89	9.01	8.15	7.31
3	10.10	9.30	8.88	6.13	7.60	6.84	5.62	8.18	3.74	5.52	5.87	6.38	8.88	8.63	8.14	7.33
4	9.37	9.26	8.83	6.08	7.09	6.85	5.61	8.25	3.60	5.30	5.85	5.82	8.88	8.42	7.77	8.00
5	9.09	9.22	8.64	6.31		5.20	4.38	7.60						8.10	7.70	
5.5	8.95	9.20						7.00								
								Lagoon								
0	11.50	9.66	8.73	4.96	7.22	6.75	6.00	7.29	5.76	6.15	6.50	6.67	8.40	8.91	8.28	8.00
1	11.50	9.67	8.72	4.94	7.20	6.57	6.00	7.25	5.77	6.14	6.49	6.69	8.18	8.87	8.27	8.00
2	11.60	9.68	8.72	4.47	6.71	6.54	5.60	7.12	5.16	5.78	6.49	6.68	6.70	8.84	8.26	7.94
3	11.60	9.62	8.53	4.31	4.76	5.96	4.60	7.00	4.30	5.75	5.00	6.30	7.10	8.55	8.18	